

Microplastics in Drinking Water Sources

Dr. Amy Borello Gruss

*Department of Civil and
Environmental Engineering*



KENNESAW STATE
UNIVERSITY

About Microplastics

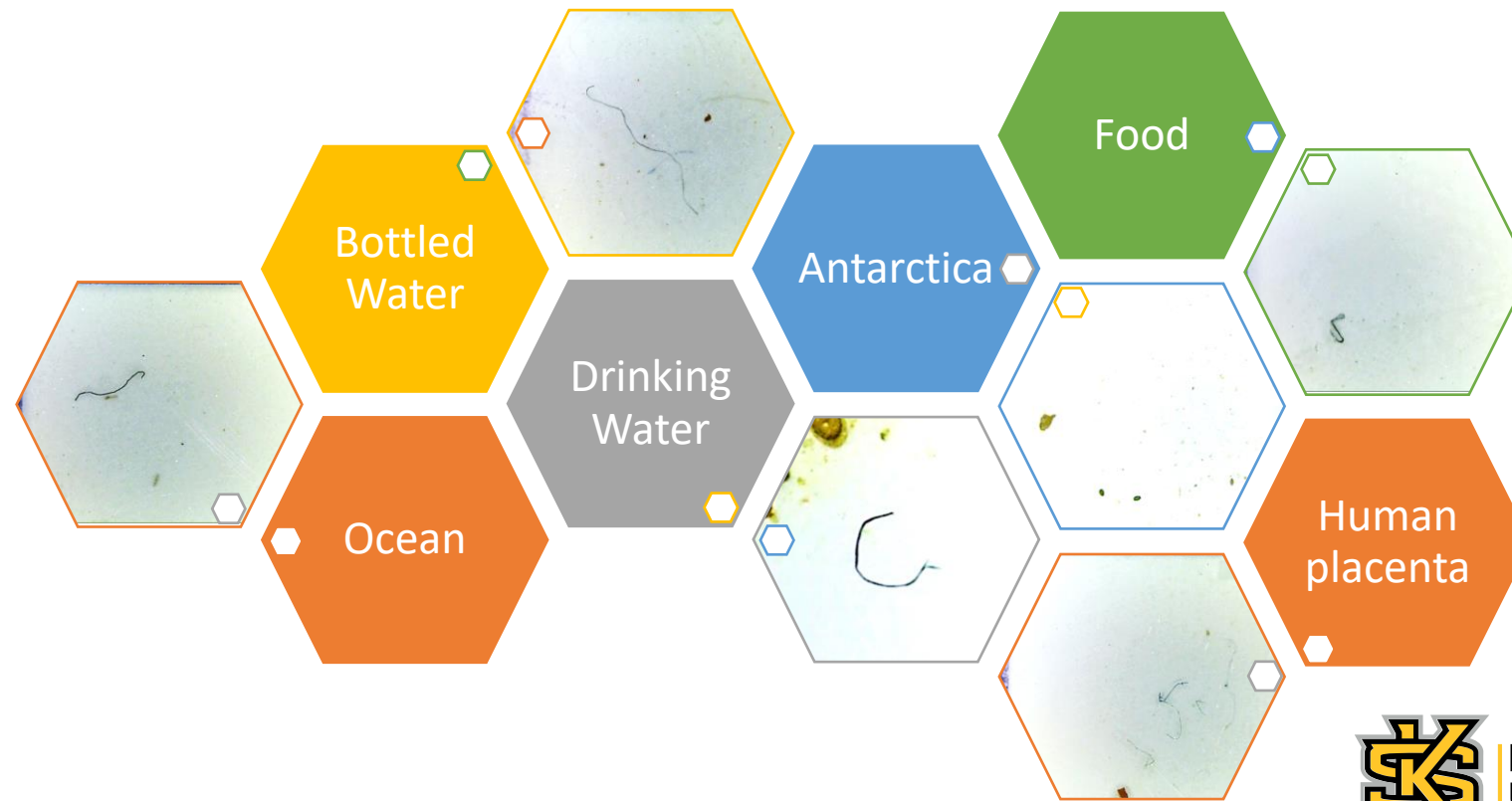
What are microplastics?

- Size:
 - Microplastics (<5 mm)
 - Nanoplastics (<100 nm)
- Cause:
 - The natural degradation and weathering of plastics
 - Anthropogenic degradation of plastics
 - Microbeads in household products
- Examples:
 - Foams, fragments, fibers, flakes
 - Breakdown of polyester clothing by the washing machine



"How worried should we be about microplastics"; The Guardian; Oct 1, 2019

Where are microplastics found?



Why we should monitor microplastics

- Human health effects...?
- Adsorption of persistent organic pollutants
- Adsorption of heavy metals
- Damaging to aquatic ecosystem
- Potential regulations

California Senate Bill No. 1422

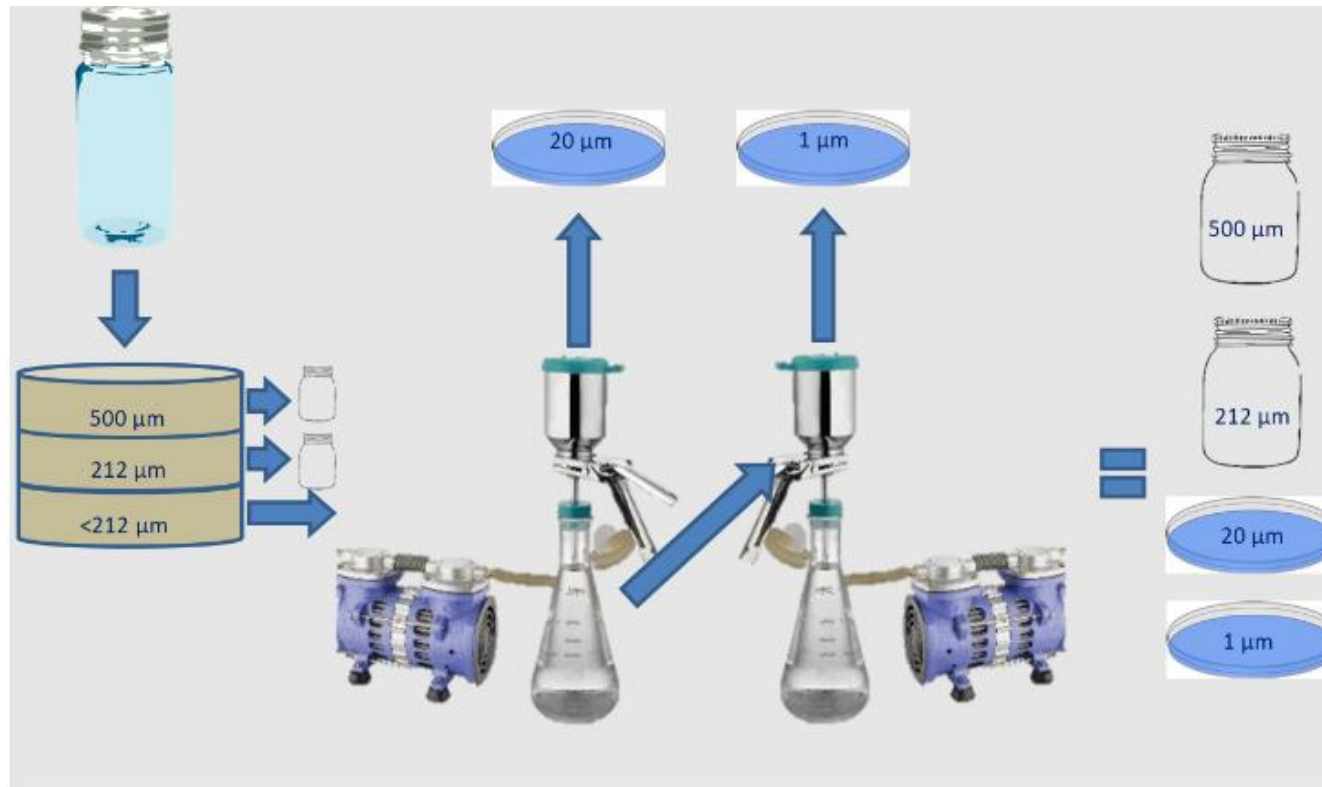
A) The state board, on or before July 1, 2020, shall adopt a definition of microplastics in drinking water.

B) The state board, on or before July 1, 2021, shall do all of the following:

- (1) Adopt a standard methodology to be used in the testing of drinking water for microplastics.
- (2) Adopt requirements for four years of testing and reporting of microplastics in drinking water, including public disclosure of those results.
- (3) If appropriate, consider issuing a notification level or other guidance to aid consumer interpretations of the results of the testing required pursuant to this section.
- (4) Accredit qualified laboratories in California to analyze microplastics.



Standard Procedure for Microplastic Extraction for Clean, Drinking Water



Flow diagram schematic of filtration procedure

Source: California Water Boards
https://www.waterboards.ca.gov/drinking_water/certlic/drinkingwater/documents/microplastics/mcrplstcs_ir.pdf

Identification of Microplastic Particles in Samples

Specific Morphology	Morphology Name Used for Reporting
Foam, Film, Fragment, Pellet	Fragment
Fiber Bundle, Fiber	Fiber
Sphere	Sphere
Fragment with rubbery consistency	Rubber fragment

Characterization of Microplastics

11.4.3.1 Spectral Collection:

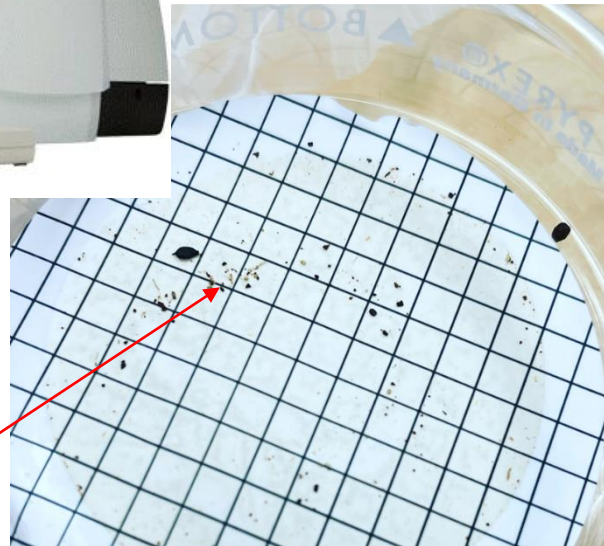
11.4.3.1.1 Use ATR or reflectance mode for particles >212 μm , and reflectance or transmittance modes for particles <212 μm , as applicable.

11.4.3.1.2 Spend a maximum of 10 mins on the spectral collection of each particle.

Not much more guidance than that – references to three paper that haven't been published yet, all by H. De Frond et al, 2021.

Characterization

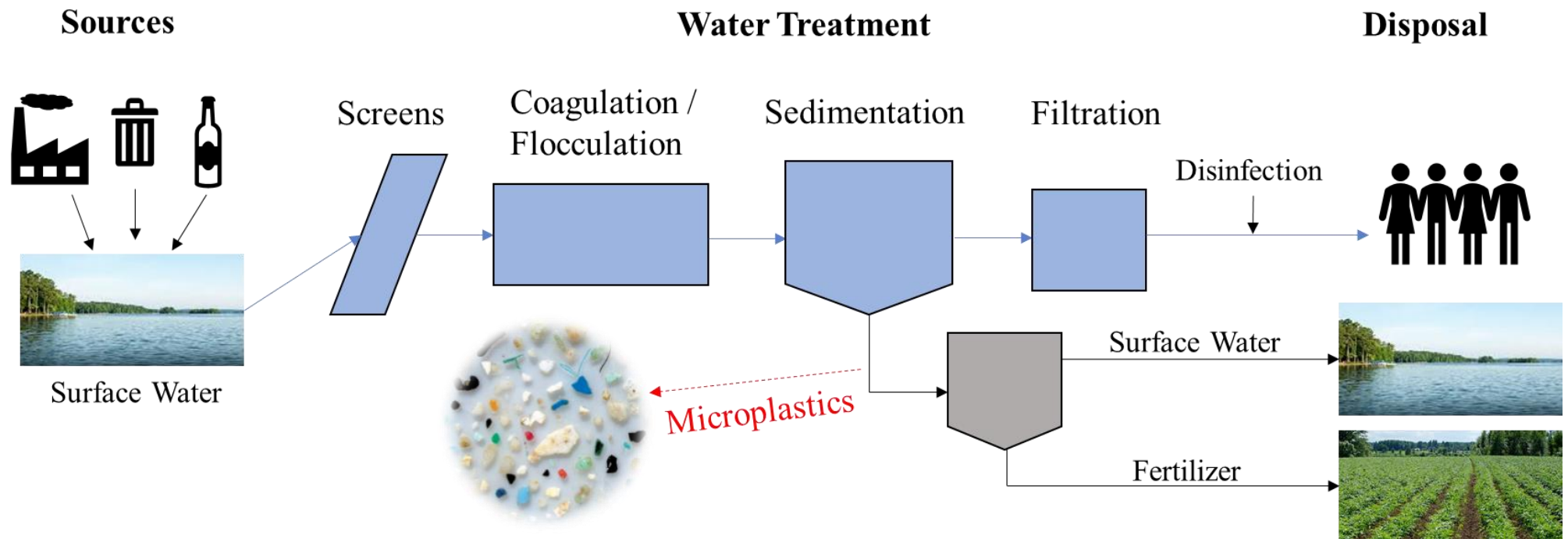
FTIR Microscope System (FTIR with Microscope)

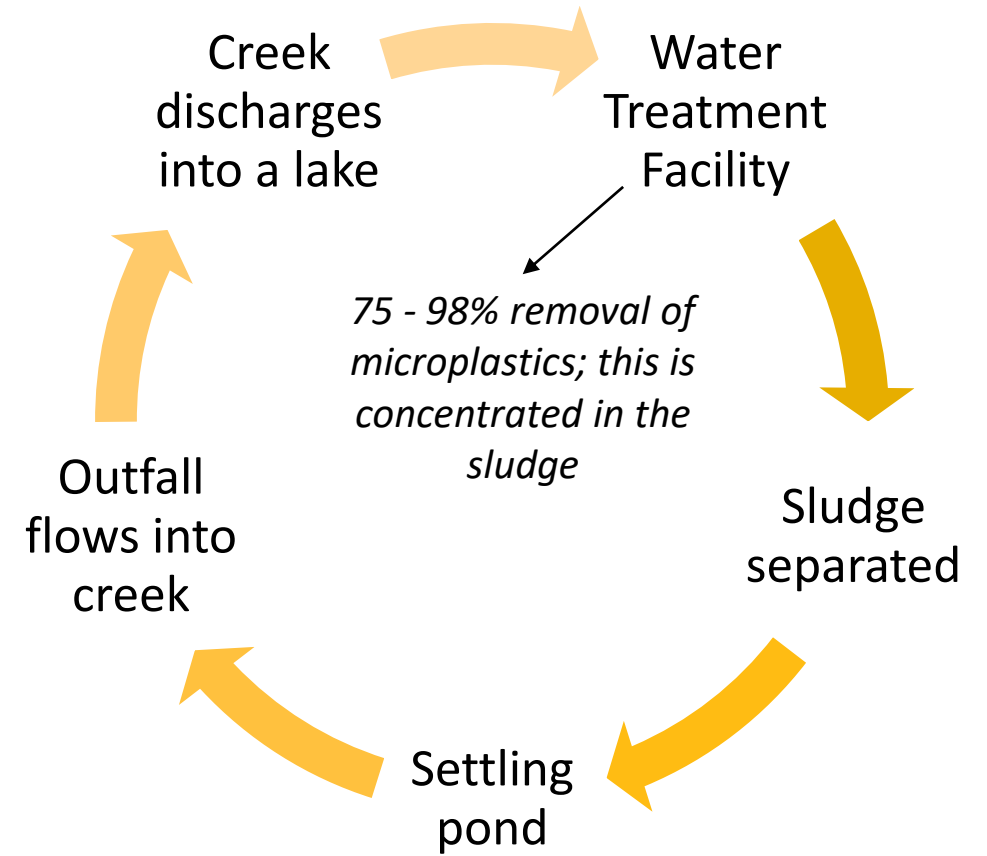


Microbead!



But there's more to test than just tap water!





Water Treatment Plant Cycling





Extraction Methodologies for complex/sludge matrices



- No standard method for sampling
- No standard method for extraction
- No standard method for characterization

The questions:

1. Are there microplastics in the drinking water sludge samples?
2. How do we successfully extract these microplastics?

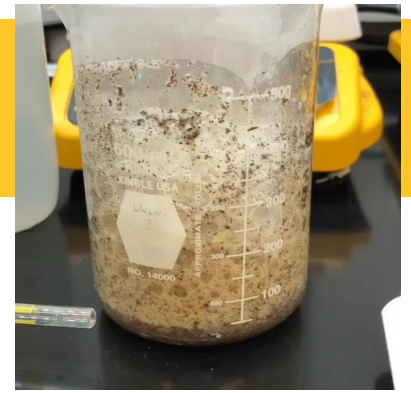
NOAA Methodology

Water Matrix

1. Wet sieving
2. Transfer of sieved solids to oven
3. Wet peroxide oxidation (WPO) with 0.05 M Fe(II) Solution and 30% hydrogen peroxide
4. Settle
5. Filtration and microscopic examination

Sediment Matrix

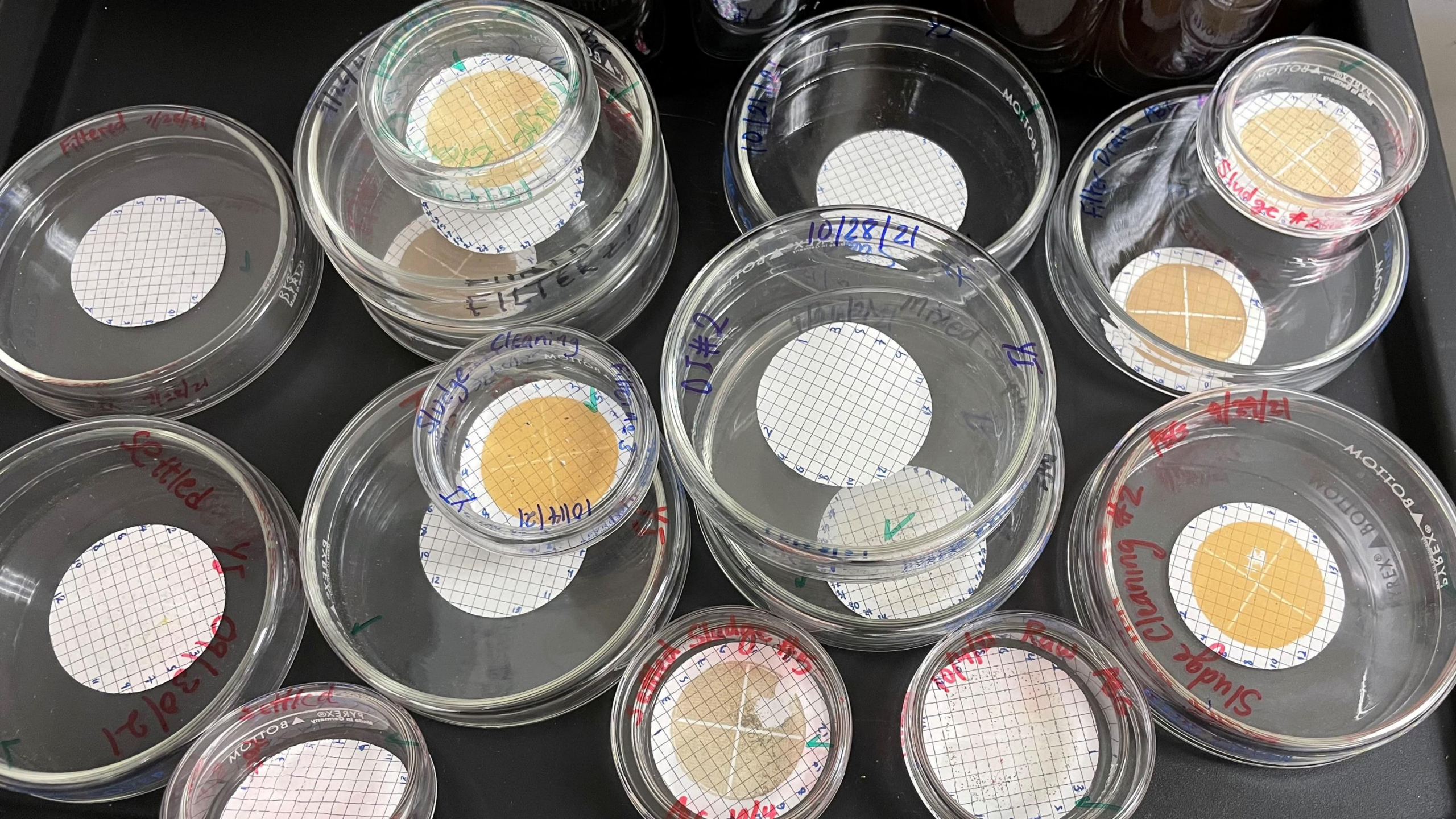
1. Oven dry sample
2. Disaggregation of dried sediments in potassium metaphosphate
3. Wet sieving and dry in oven
4. Density separation by settling using lithium metatungstate
5. WPO with 0.05 M Fe(II) Solution and 30% Hydrogen Peroxide
6. Density separation by settling
7. Filtration and microscopic examination



Microscope Methodology



- Filtered samples were analyzed on filter paper underneath a 3.5X-180X Zoom Stereo Microscope.
- The filter paper was labeled by quadrants to be able to analyze the samples easier and more efficiently.
- A total of microplastics are counted.



Results from Environmental Samples



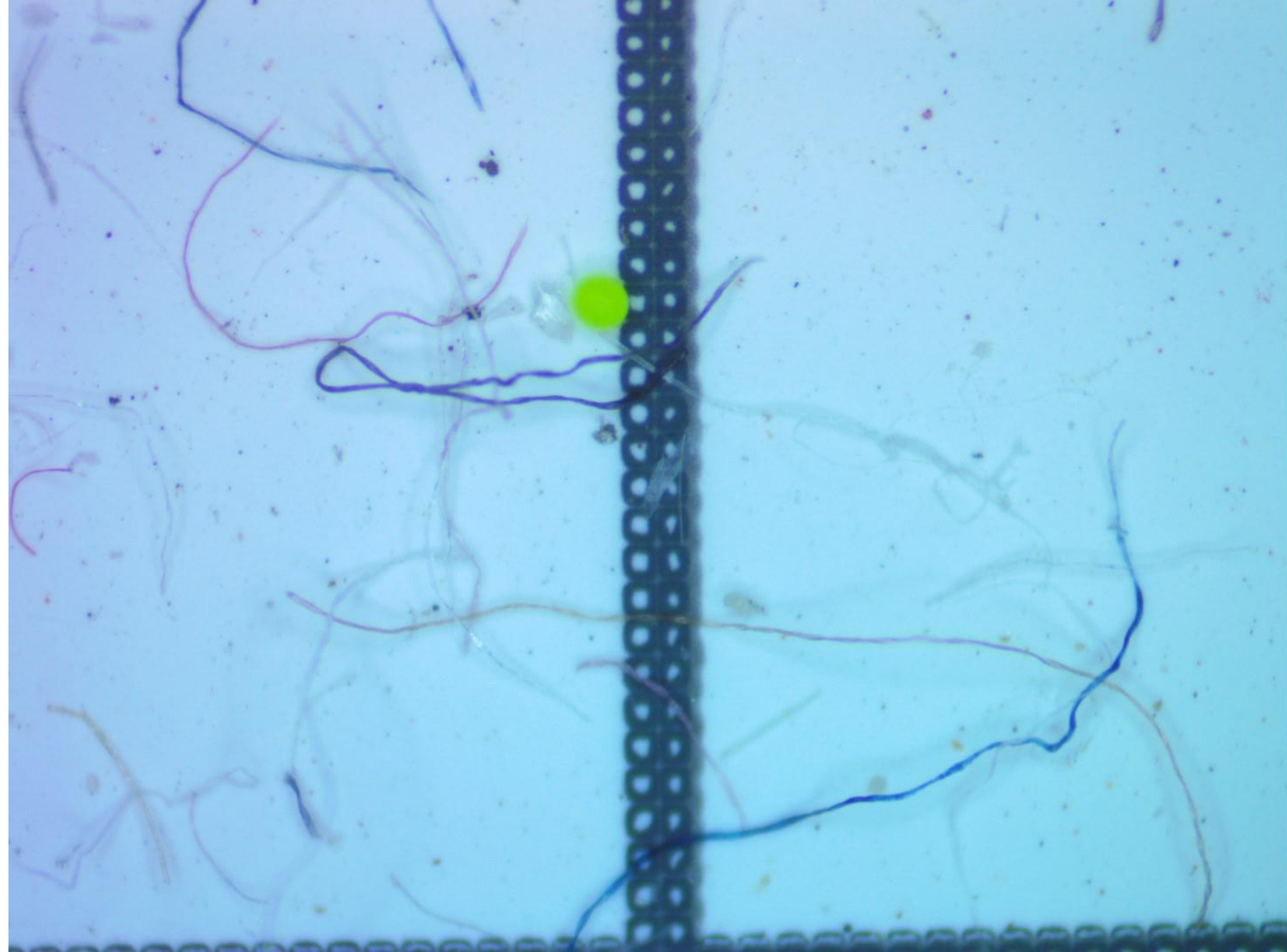
Example of Microplastic
Fragment Under Microscope



Example of Microplastic
Fiber Under Microscope



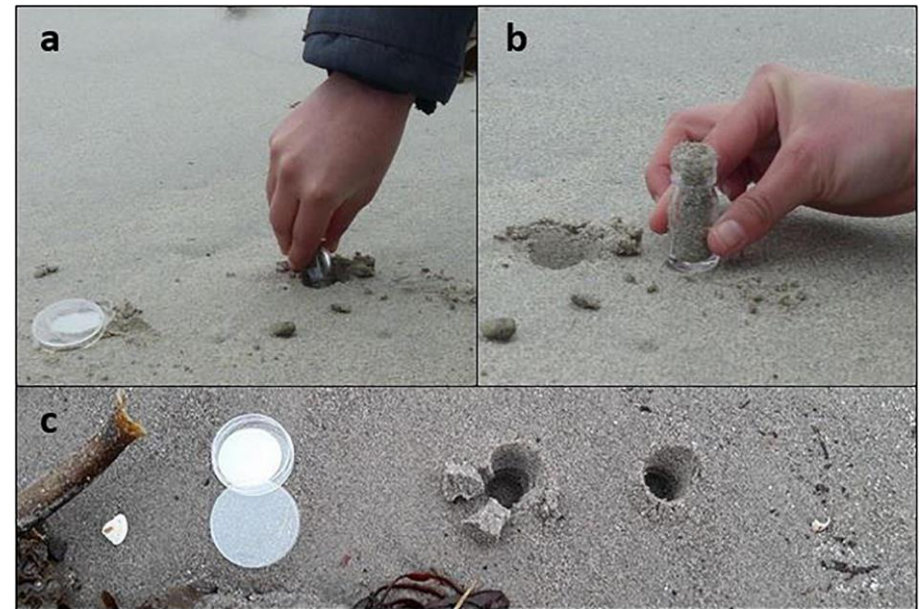
Example of Organic Material
Under Microscope



Citizen Scientists - sampling

Sediment:

- Top 5-cm of beach sediment sampled
- Three options for analysis:
 1. Sample placed in drying oven at 50-deg C, separated with oil
 2. Direct sampling with forceps
 3. Sieving

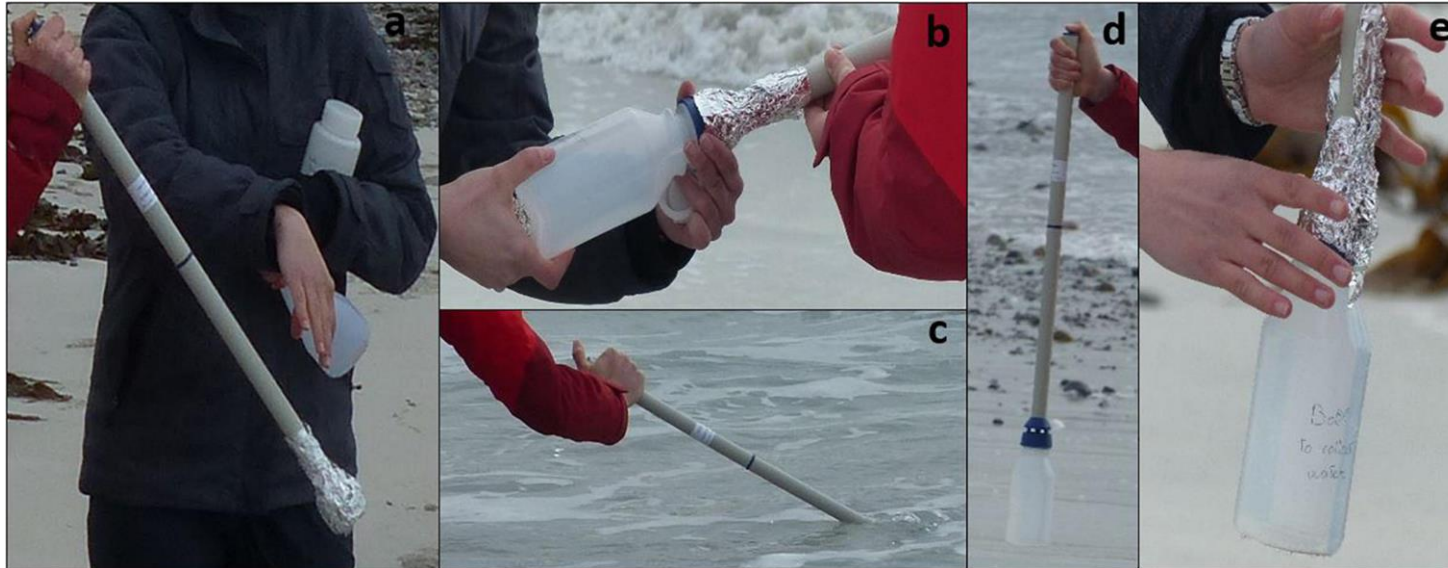


Ref: Frontier Mar. Sci., 04 June 2021; <https://doi.org/10.3389/fmars.2021.657709>

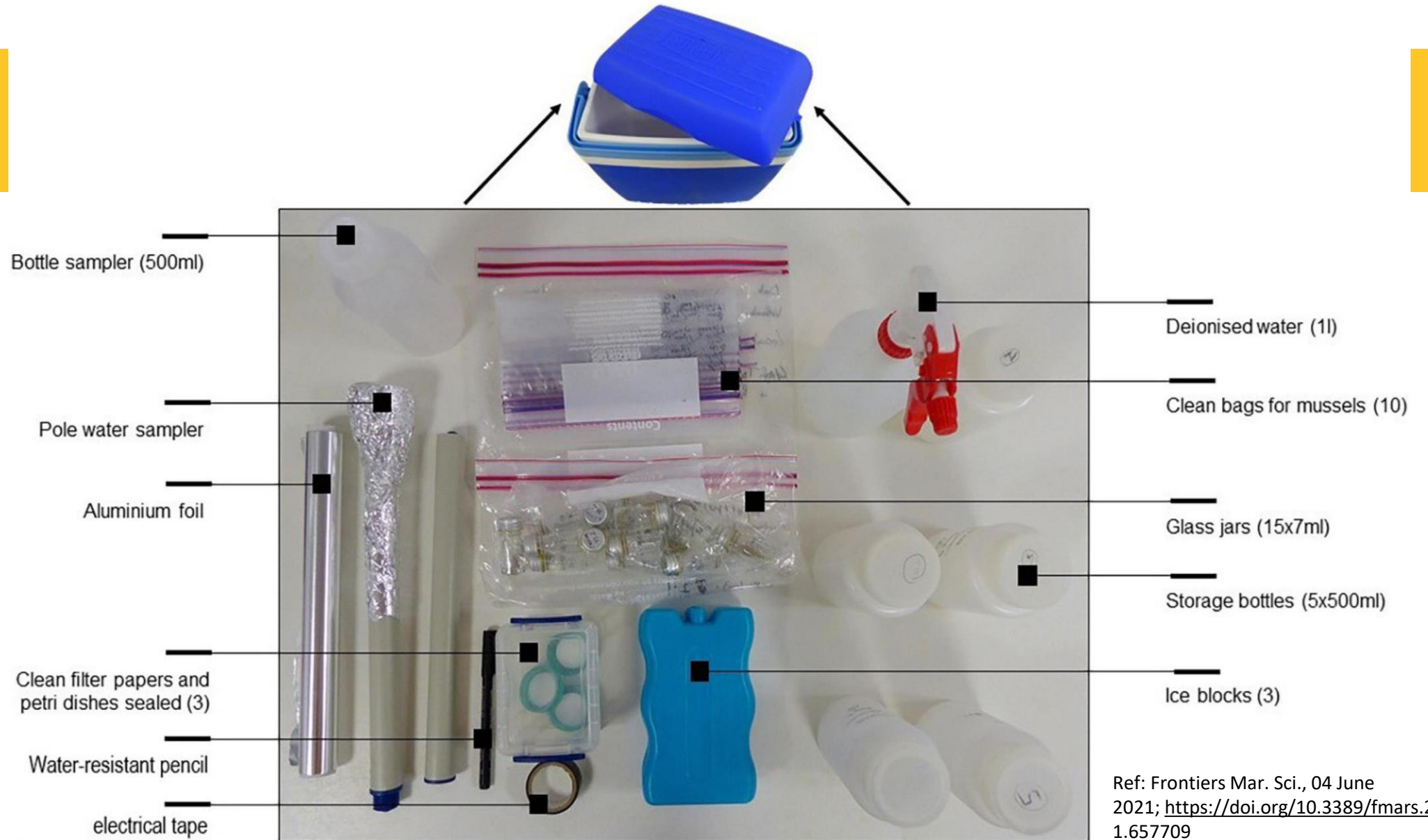
Citizen Scientists - sampling

Water:

- 500 ml, wrapped in foil
- Filtered onto filter paper via funnel and vacuum pump
- Filter placed in glass petri dish for analysis



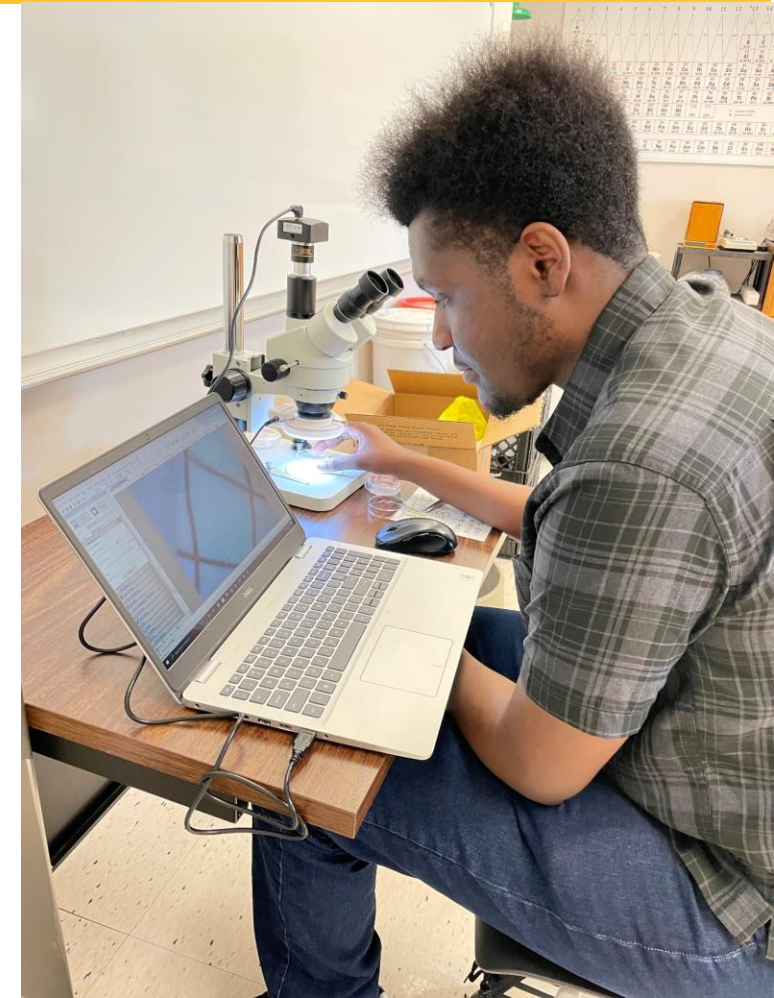
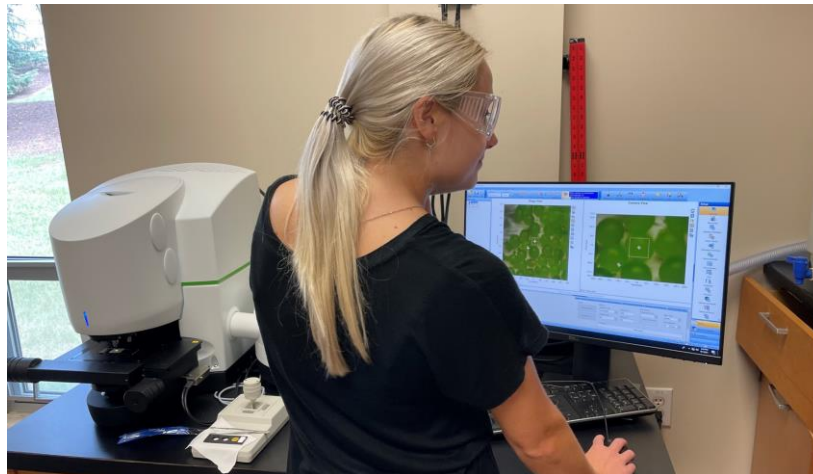
Citizen scientists tool-kit



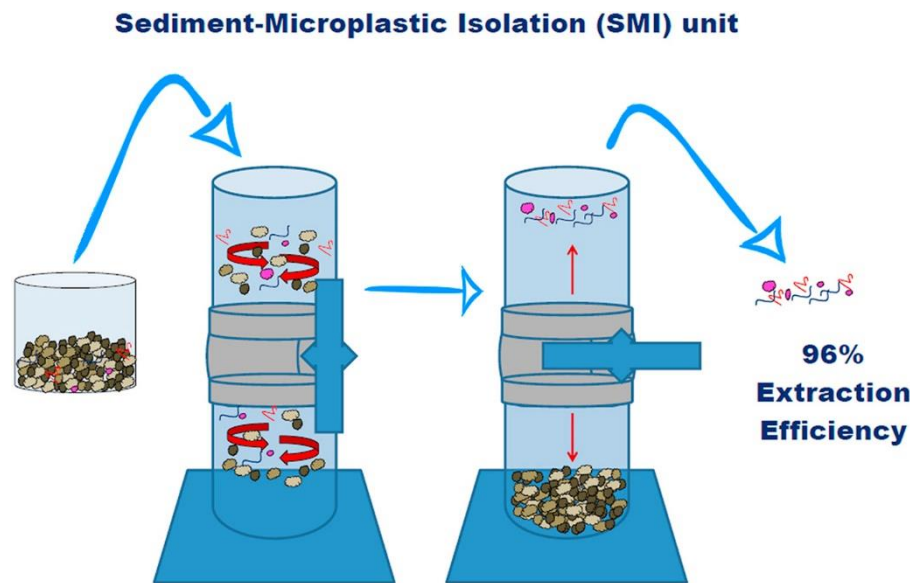
Ref: Frontiers Mar. Sci., 04 June 2021; <https://doi.org/10.3389/fmars.2021.657709>

Citizen Scientists – Identification and Characterization

- Filter paper visually inspected using a dissecting microscope
- Confirm its polymer type using an FTIR (Fourier Transform Infrared Spectrometer)



Future work with sediment samples



“A small-scale, portable method for extracting microplastics from marine sediments” Coppock, et al., 2017

A less destructive method needs to be developed to remove microplastics from complex matrices

- Physical removal rather than chemical
- Development of a physical density separator



Thank you!

Contact info for Dr. Gruss:



agruss@kennesaw.edu



[professorgruss](https://www.instagram.com/professorgruss)

